

**STABLE POLYOL DISPERSIONS, POLYURETHANE  
MOLDINGS PRODUCED THEREFROM, AND THEIR USE**

**BACKGROUND OF THE INVENTION**

5 The present invention relates to polyol dispersions with long-term stability, to cellular polyurethane moldings produced therewith, to processes for their preparation and to their use.

DE-A 2 307 589 describes the production of easy-release polyurethane moldings (PUR moldings) using polyisocyanates modified with fatty acid esters. DE-A 2 121 670  
10 discloses the production of easy-release PUR moldings using special release agents introduced into the reaction via the polyol. To achieve a substantial release effect, the release agents are preferably added to both the isocyanate component and the polyol component before they are reacted together.

In recent years, attempts have been made preferentially to dispense with the conventional  
15 physical blowing agents in the production of PUR moldings. When using water as the blowing agent, however, the conventional polyol formulations tend to exhibit greater instability and more rapid phase separation, so either they cannot be stored for long periods or expensive measures have to be taken to prevent phase separation.

The object of the present invention was therefore to provide polyol formulations for the  
20 production of cellular polyurethane moldings with good release properties which, although they contain water as the blowing agent, are sufficiently stable and only exhibit phase separation after prolonged storage, if at all.

Surprisingly, it has been found that, by using specific release agents, not only is a good  
release of the molding assured, but also the polyol formulation prepared which contains  
25 these mold release agents, is stable and only tends to exhibit phase separation after a prolonged period, if at all.

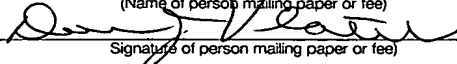
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SUMMARY OF THE INVENTION

The present invention provides stable dispersions of polyol formulations which are suitable for polyurethane moldings. These stable dispersions comprise:

- a) a polyol component comprising:
  - 5 a1) one or more polyetherpolyols with an OH number of 350 to 1830 mg KOH/g and a functionality of 2 to 8,  
and
  - a2) optionally up to 40 wt.%, based on the combined weight of components a) + b), of one or more polyesterpolyols with an OH number of 250 to  
10 500 mg KOH/g and a functionality of 2 to 3,
- b) optionally, one or more polyetherpolyols with an OH number of 15 to 250 mg KOH/g and a functionality of 2 to 6,
- c) one or more release agents selected from the group consisting of:
  - c1) one or more release agents containing ester groups and comprising the  
15 reaction product of:
    - (i) one or more fatty acids having 10 to 40 carbon atoms,
    - (ii) optionally, one or more dicarboxylic acids or polycarboxylic acids,  
and
    - 20 (iii) one or more polyetherpolyols with ethylene oxide and/or propylene oxide units in the molecule with an OH number of 200 to 1,000 KOH/g and a functionality of 2 to 6, wherein up to 50 equivalent percent of these polyetherpolyols may be replaced by other polyols which are free of ethylene oxide and/or propylene  
25 oxide units in the molecule;

- c2) one or more release agents containing amide groups,  
and
- c3) mixtures thereof;
- d) optionally, water or a mixture thereof with one or more physical blowing agents,
- 5 e) optionally, one or more activators,
- f) optionally, one or more stabilizers,  
and
- g) optionally, other additives and/or auxiliary substances,

The present invention also provides cellular polyurethane moldings comprising the  
10 reaction product of the stable dispersions of polyol formulations as described above with  
organic isocyanates such as organic polyisocyanates, modified organic polyisocyanates  
and organic polyisocyanate prepolymers.

The process of preparing the stable dispersions according to the present invention is  
another aspect of the present invention. This process comprises mixing components a) to  
15 g) as described above together.

The process for the production of the cellular polyurethane moldings of the present  
invention comprises reacting the dispersions according to the invention with one or more  
organic isocyanates.

The following may be mentioned as preferred isocyanate components:

- 20 Polyisocyanates of the diphenylmethane series including, for example diphenylmethane  
4,4'-diisocyanate, diphenylmethane 2,4'-diisocyanate, polymeric diphenylmethane  
diisocyanates, such as those obtained by the phosgenation of aniline/formaldehyde  
condensation products, and liquefied or modified diphenylmethane diisocyanates, such as  
those obtainable by reaction with carbodiimide or urethane. Modified isocyanates are  
25 understood as meaning, for example, isocyanurates, biurets, allophanates and uretdiones.

Polyisocyanates of the toluene diisocyanate series are also preferred.

The polyetherpolyol of component a) in the present invention preferably consists of compounds containing reactive OH groups which have an OH number of 350 to 1830 mg KOH/g. These polyhydroxyl compounds preferably have from 2 to 8 hydroxyl groups, more preferably from 2 to 6 hydroxyl groups, and are made up of ether groups. These polyetherpolyols are preferably prepared by the known processes involving the addition of propylene oxide and/or ethylene oxide onto starter compounds such as, for example, glycerol, trimethylolpropane, pentaerythritol, sorbitol and/or sucrose. These polyetherpolyols preferably have predominantly secondary OH groups, but primary OH groups may also be present in the polyetherpolyols.

If present, the polyesterpolyol of component a) in accordance with the present invention preferably comprises compounds prepared by the condensation of dicarboxylic acids or dicarboxylic anhydrides such as, for example, adipic acid, phthalic anhydride and maleic anhydride, with glycols such as, for example, ethylene glycol, propylene glycol, butanediol, glycerol and trimethylolpropane. Suitable polyesterpolyols generally have an OH number of 250 to 500 mg KOH/g and a functionality of 2 to 3.

The polyetherpolyols suitable for component b) in accordance with the present invention generally have an OH number of 15 to 250 mg KOH/g and a functionality of 2 to 6. Suitable polyetherpolyols are preferably prepared by the addition of propylene oxide and/or ethylene oxide onto a suitable starter compound such as, for example, trimethylolpropane, glycerol, propylene glycol, pentaerythritol, sorbitol, bisphenol A and/or hydroquinone.

Suitable release agents for the present invention are selected from the group consisting of c1) release agents containing ester groups, c2) release agents containing amide groups and c3) mixtures thereof.

Suitable release agents containing ester groups to be used as component c1) are those comprising the reaction product of (i) one or more fatty acids having 10 to 40 carbon atoms, (ii) optionally, one or more dicarboxylic or polycarboxylic acids, and (iii) one or more polyetherpolyol components with an OH number of 200 to 1000 mg KOH/g and a functionality of 2 to 6. Suitable polyetherpolyols for (iii) are preferably those

components based on glycerol, pentaerythritol, sorbitol and trimethylolpropane as starters, and alkoxylated with ethylene oxide. Release agents c1) are obtained by esterifying these polyetherpolyols with fatty acids which preferably have 10 to 40 carbon atoms. The suitable fatty acids include, for example, oleic acid, linoleic acid, stearic acid, soya oil fatty acid and montan wax acid. The esterification can optionally be carried out in the presence of one or more dicarboxylic or polycarboxylic acids.

The polyetherpolyol component used for the preparation of the release agents which contain ester groups, i.e. component c1), is preferably a polyetherpolyol based on ethylene oxide (preferably from 60 to 100 mol%, based on 100 mol% of ethylene oxide and propylene oxide), and optionally, corresponding proportions of propylene oxide, with suitable compounds as starters including, for example, 1,4-butanediol, ethylene glycol, 1,6-hexanediol, trimethylolpropane, pentaerythritol, glycerol, sorbitol, bisphenol A and mixtures thereof.

If present, release agents c2) which preferably consists of amide salts, such as, for example, those obtainable by reacting amines with a molar excess of fatty acids having 10 to 40 carbon atoms. The amines contain at least one tertiary amino group and at least one primary or secondary amino group.

It is preferable to use one or more activators in order to accelerate the blowing and crosslinking reaction. Examples of suitable activators being 1,4-diazabicyclo[2.2]octane, dimethylcyclohexylamine, bis(2-dimethylaminoethyl)methylamine, dimethylbenzylamine, tin(II) di-2-ethylhexoate and dimethyltin(IV) dilaurate.

The suitable stabilizers for the present invention include, preferably, the known polysiloxanes modified by polyethylene oxide, polypropylene oxide and polyetherpolyols.

Examples of other additives which may also be used in the present invention include flameproofing agents, dyes, anti-ageing additives and emulsifiers.

The dispersions according to the invention are preferably used in the production of cellular moldings.

## EXAMPLES

5 A. Component c1) containing ester groups [fatty acid polyester; FAPE]:

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**FAPE 5:** the reaction product of 4236 g of oleic acid, 365 g of adipic acid and 2540 g of a polyether with an OH number of 600 prepared by the addition of ethylene oxide (EO) onto trimethylolpropane (TMP) as starter; wherein the reaction product had an OH number of 44 and an acid number of 2

5        FAPE 6:        the reaction product of 847 g of oleic acid, 73 g of adipic acid and 494 g of a polyether with an OH number of 600 prepared by the addition of propylene oxide (PO) onto pentaerythritol as starter; wherein the reaction product had an OH number of 45 and an acid number of 3

10       FAPE 7:        the reaction product of 3560 g of oleic acid, 306 g of adipic acid, 533 g of a polyether with an OH number of 600 prepared by the addition of EO onto TMP, and 1600 g of a polyether with an OH number of 600 prepared by the addition of PO onto TMP; wherein the reaction product had an OH number of 47 and an acid number of 2.7

15       FAPE 8:        the reaction product of 1695 g of oleic acid, 306 g of adipic acid, 508 g of a polyether with an OH number of 600 prepared by the addition of EO onto TMP, and 223 g of trimethylolpropane; wherein the reaction product had an OH number of 43 and an acid number of 2

20       FAPE 9:        the reaction product of 1695 g of oleic acid, 146 g of adipic acid and 560 g of a polyether with an OH number of 1000 prepared by the addition of EO onto glycerol; wherein the reaction product had an OH number of 43 and an acid number of 2

These fatty acid polyester products were prepared by heating the components at 160°C - 200°C over approx. 20 hours, followed by esterification for 10 hours at 200°C under vacuum. The acid number, the OH number and the molecular weight of the resultant product were determined.

25    B.        Component a):

Polyetherpolyol 1:

Polyether having an OH number of 830 obtained by the addition of propylene oxide onto trimethylolpropane.

## C. Component b):

Polyetherpolyol 2:

5 Polyether having an OH number of 42 (with mostly secondary OH-groups) obtained by the addition of propylene oxide and ethylene oxide (as a mixture) onto a mixture of trimethylolpropane and propylene glycol (molar ratio 3:1).

## D. Activators e) and stabilizers f):

Stabilizer: Tegostab B 84 11 from Goldschmidt

Activator: Desmorapid® 726 b from Bayer AG

E. Isocyanate:

10 95 parts by weight (0.38 mol) of a polyisocyanate prepared by the phosgenation of aniline/formaldehyde condensation products and having a viscosity of 320 cP at 25°C and an NCO content of 31.5 wt.%,

and

15 5 parts by weight (0.004 mol) of a fatty acid ester comprising the reaction product of: 544 parts by weight of pentaerythritol, 3390 parts by weight of oleic acid and 292 parts by weight of adipic acid;

wherein the resultant fatty acid ester was characterized by an OH number of 19.5, an acid number of 25.0, and a molecular weight of about 1100

20 The two components were reacted at 70°C. The reaction mixture was kept at 70°C for 4 hours, with stirring. When the reaction was complete, the NCO content of the polyisocyanate containing the reaction product was 29 wt.%.

F. Release agents c2) containing amide groups:

25 Amidoamine/oleic acid salt (prepared from 1 mol of 3-dimethylamino-1-aminopropane and 2 mol of oleic acid)



**Preparation of the dispersions and their stability:**

Components a) to g) were mixed at 1000 rpm for 60 seconds at room temperature by means of a Pendraulik stirrer and left to stand in a closed vessel. The settling behavior of the dispersions prepared in this way was observed. The results and the compositions (in parts by weight) can be found in the Table below:

**Table 1:** Stability of the dispersions

Dispersion no. Component	1*	2*	3*	4	5	6	7	8	9	10
Polyether 1	60	60	60	60	60	60	60	60	60	60
Polyether 2	40	40	40	40	40	40	40	40	40	40
Amidoamine	3	3	3	3	3	3	3	3	3	3
Water	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FAPE 1	3	3								
FAPE 2			3							
FAPE 3				3						
FAPE 4					3					
FAPE 5						3				
FAPE 6							3			
FAPE 7								3		
FAPE 8									3	
FAPE 9										3
Stability in days	13	4	5	10	20	>50	20	35	23	25

\* Comparative dispersions; the amounts are given in parts by weight

Examples 4 to 10 in Table 1 show the markedly improved stability of the polyetherpolyol dispersions according to the invention.

- 10 The behavior of the fatty acid polyester FAPE 5 was outstanding, with a dispersion stability of over 50 days.

The proportionate accompanying use of a polyetherpolyol for the preparation of component c1) together with trimethylolpropane (see, for example, dispersion 9 which

containing FAPE 8) already improved the stability to 23 days, compared with dispersion 3 which contained FAPE 2, prepared with trimethylolpropane as the polyol component. Dispersion 3 had a stability of only 5 days.

An increased stability of the dispersions which contain fatty acid polyesters, i.e. release agents c1), was also achieved without amidoamines, i.e. release agents c2). See Table 2 below.

**Table 2:** Stability of the dispersions without c2)

Dispersion no. Component	11*	12
Polyether 1	60	60
Polyether 2	40	40
Water	0.5	0.5
FAPE 1	3.0	-
FAPE 5	-	3.0
Stability in days	1	25

\*Comparative dispersion; the amounts are given in parts by weight

Example 12 in Table 2 shows that the dispersion containing fatty acid polyester c1) according to the invention had a substantially longer stability than dispersion 11 not according to the invention.

#### Production of the PUR moldings and their release properties:

The starting components in Table 3 were used in the amounts shown.

The polyol mixture and blowing agents were fed into a 2-component proportioning mixer, where they were mixed vigorously with the polyisocyanate to produce the foaming reaction mixture and transferred immediately to an aluminium mold heated to 60°C.

The mold had dimensions of 200 x 300 x 10 mm. Both the mold and the molding of the clamping unit were kept at a temperature of 60°C.

An external release agent was not used.

The composition of the moldings in parts by weight, and the results of the tests, can be found in the Table below:

**Table 3:** Properties of the PUR moldings and their composition

Example no. Component	1 (comparative)	2	3	4	5
Polyol 1 [parts by weight]	60	60	60	60	60
Polyol 2 [parts by weight]	40	40	40	40	40
Amidoamine salt [parts by weight]	3	3	3	3	-
Stabilizer B 84 11 [parts by weight]	0.8	0.8	0.8	0.8	0.8
Activator: Desmorapid 726 b [parts by weight]	1.0	1.0	1.0	1.0	1.2
Water [parts by weight]	0.5	0.5	0.5	0.5	0.5
FAPE 2 [parts by weight]	3				
FAPE 5 [parts by weight]		3			3
FAPE 7 [parts by weight]			3		
FAPE 9 [parts by weight]				3	
Mixing ratio: 100 parts by weight of polyol formulation to parts by weight of isocyanate	132	132	132	132	134
Index 100					
Bulk density of mold [kg/m <sup>3</sup> ]	600	600	600	600	600
Demolding time [min]	3	3	3	3	3
Shore D hardness	70	70	70	70	70
Number of demolded parts with slab dimensions of 300 x 200 x 10 mm	>35	>35	>35	>35	>35

- 5 The release properties of the PU moldings according to the invention were perfect in all the Examples in Table 3.

The experiments were discontinued after the 35th demolding in each case because the moldings and the material in the sprue region were easily removable.

Although the invention has been described in detail in the foregoing for the purpose of illustration, it is to be understood that such detail is solely for that purpose and that variations can be made therein by those skilled in the art without departing from the spirit and scope of the invention except as it may be limited by the claims.